REMARKS

An Excess Claim Fee Payment Letter and fee is included herewith for excess dependent claims.

Claims 1-33, are all the claims presently pending in the application. New claims 31-33 have been added to more completely define the invention and which also recite the gist of the invention.

It is noted that the claims have been amended solely to more particularly point out Applicant's invention for the Examiner, and not for distinguishing over the prior art, narrowing the claim in view of the prior art, or for statutory requirements directed to patentability.

It is further noted that, notwithstanding any claim amendments made herein, Applicant's intent is to encompass equivalents of all claim elements, even if amended herein or later during prosecution.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached pages are captioned "**Version with markings to show changes made**".

Claims 1, 12 and 23 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Nishioka (U.S. Pat. 4,767,495) (hereinafter "Nishioka").

Claims 1-30 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishioka and Jackson et al. (U.S. Pat. 5,335,113) (hereinafter "Jackson"). .

These rejections are respectfully traversed in the discussion below.

I. THE CLAIMED INVENTION

Applicant's invention, as defined for example in independent claim1 (and substantially similarly in independent claims 12 and 23) is directed to a method of etching a substrate which includes measuring a reflectance signal from a reflective material deposited on the substrate as the substrate is being etched.

A feature of the present invention, in a non-limiting embodiment is that a reflective material may be isolated from an etching process.

With the unique and unobvious method of the invention, a reflectance correlation may be obtained between a primary film being etched and a secondary film being used only to correlate and trigger an endpoint on the primary film. Thus, the output being monitored for endpoint detection does not have to physically represent the film being etched. Such a feature results in an improved turn-around-time, low cost, improved efficiency, and improved manufacturability (e.g., see page 5, lines 13-20; page 7, lines 5-20; and page 9, lines 1-12).

An exemplary configuration of the present invention is shown being applied to a structure in Figure 4A, 5A, and 6A of the application.

The conventional systems, such as those discussed below and in the Related Art section of the present application, do not have such a structure, and fail to provide for such an operation.

Indeed, such features are clearly not taught or suggested by the cited references.

II. THE 35 U.S.C. 112, SECOND PARAGRAPH REJECTION

Claims 7, 18, and 29 stand rejected on informalities (e.g., 35 U.S.C. 112, second paragraph). Claims 7, 18, and 29 have been amended in a manner believed fully responsive to all points raised by the Examiner.

III. THE PRIOR ART REFERENCES

A. The Nishioka Reference

The Examiner asserts that:

> *[Regarding claims 1, 12 and 23] Nishioka discloses a method (Fig. 3A-3C) of etching a substrate comprising: measuring a reflectance signal L_{RO} from a reflective material 3 deposited on said substrate 1, 2 as the substrate is being etched; correlating the substrate etch rate to the reflectance signal from the reflective material (col.5, section "B"); and using the etch relation between the substrate and the reflective material to determine the etch target.*

However, Applicant respectfully disagrees.

Specifically, in a non-limiting embodiment of the present invention, the method of the invention, as shown in Figs. 4A, 5A, and 6A, is applied to a structure with a substrate 41 (e.g., primary film), a metal layer 42, an oxide 43 (e.g., secondary film), and a resist 44 in that order. A laser 45 emits a signal passing though oxide 43 and striking metal 42 and a reflectance from the metal 42 (e.g., which is correlated with an etch rate of the substrate 41) is measured.

Thus, in the present invention, a reflectance correlation may be obtained between a primary film being etched and a secondary film being used to correlate and trigger an endpoint on the primary film. The output being monitored (e.g., the reflectance from metal 42) does not physically represent the film being etched (e.g., substrate 41).

Contrary to the Examiner's assertions, Nishioka is entirely different and does not teach or suggest the novel features of the present invention. For example, Nishioka discloses "*[t]he present invention is directed to a method of detecting a termination time or endpoint of a surface layer removal processing for <u>removing a surface layer provided on a substrate</u>*" (e.g., see column 2, lines 18-21 of Nishioka). Thus, Nishioka does <u>not</u> disclose etching the substrate itself.

Further, in Nishioka (e.g., as disclosed in column 5, lines 40-48 and equations 2-3) an intensity signal for an endpoint is obtained by observing the <u>phase difference</u> between LR1 (e.g., surface layer reflectance of material 2) and LRA (e.g., mask and substrate reflectance of materials 1 and 3 respectively). The phase difference generates <u>a sinusoidal intensity</u> as the surface layer (material 2) is being etched. Once material 2 has been completely etched the signal becomes flat because LR1 = LRA (i.e. the phase difference becomes constant). Thus, in Nishioka <u>two types of reflected light are being compared</u>.

Additionally, <u>Nishioka does not correlate a substrate etch rate to the reflectance signal from the reflective material</u> because Nishioka is <u>not</u> etching the substrate.

Also, in Nishioka an intensity signal is based on the etch relation between all three materials (mask, surface layer, and substrate).

In sharp and fundamental contrast, the method of the present invention, is much different and applied to a different structure. As shown in a comparison of Fig. 3B of Nishioka and Fig. 4A of the present invention, Nishioka does not apply a method to a substrate 41 (e.g., primary

film), a metal layer 42, an oxide 43 (e.g., secondary film), and a resist 44 in that order. Instead, as shown in Fig. 3B of Nishioka there is only a silicon substrate 1, a silicon oxide layer 2 and a resist layer 3.

In the present invention, there is no surface layer material (e.g., silicon oxide layer 2) as shown in Fig. 3A-3C of Nishioka.

Additionally, in the present invention the substrate 41 is being etched.

Further, in the present invention there is no obvious change in the intensity signal to signify endpoint. Instead, the intensity signal resulting from this method is a linear relationship as shown in Figs. 4B, 5B, 6B, and Fig. 8 and as defined by dependent claims 10 and 21(e.g., in sharp and fundamental contrast to the sinusoidal relationship of a signal depicted in Figs. 5, 9, 6A, 6B, 8A, 8B, 8C, 8D, 8E, 11A, 11B, 11C, 11D, 13, and 14 of Nishioka). Thus, in the present invention, an endpoint is not determined by a change in slope of the intensity signal determined by completely etching a silicon oxide layer 2.

Further, the only reflectance signal being observed in the present invention is the reflection of laser 45 which passes through the oxide 43 and reflects off the metal layer. In contrast, in Nishioka, there are multiple reflection signals being observed (e.g., L_R and L_{RA} composed of multiple reflectance signals). The reflectance signals in Nishioka include signals from materials which are subject to etching. Thus Nishioka does not teach or suggest "*said reflective material is isolated from an etching process*", as defined by the claimed invention.

Thus, turning to the language of the claims, there is no teaching or suggestion by Nishioka of the novel present invention in which "*[a] method of etching a substrate, comprising:*

measuring a reflectance signal from a reflective material deposited on said substrate as the substrate is being etched;

correlating the substrate etch rate to the reflectance signal from the reflective material; and

using the etch relation between the substrate and the reflective material to determine the etch target,

wherein said reflective material is isolated from an etching process" (emphasis Applicant's) as recited in independent claim 1 (and substantially similarly in independent claims 12 and 23).

Thus, independent claims 1, 12, and 23 are neither anticipated nor for that matter rendered obvious by Nishioka.

B. The Nishioka and Jackson Reference

The Examiner asserts that:

> *[Regarding claims 1-30] Nishioka discloses a method (Fig. 3A-3C) of etching a substrate comprising: measuring a reflectance signal L_{RO} from a reflective material 3 deposited on said substrate 1, 2 as the substrate is being etched; correlating the substrate etch rate to the reflectance signal from the reflective material (col.5, section "B"); and using the etch relation between the substrate and the reflective material to determine the etch target*
>
> *The substrate of Nishioka discloses to etch silicon oxide, for which is it obvious to have quartz. However, Nishioka does not disclose the combination of chrome and quartz for the substrate and reflective material.*
>
> *Jackson teaches that the combination of etching quartz through a chrome mask is a well known structure and process (col. 6, line 55-col.7, line 4).*
>
> *It would have been obvious to use chrome and quartz as the mask and substrate in the method of Nishioka because the method of Nishioka is applicable to several mask and etch structures, and Jackson teaches that the structure of chrome and quartz is a useful structure for masking and etching.*
>
> *As to claim 7, Nishioka discloses that the mask layer being monitored is not the layer being etched, thus the output being monitored does not physically represent the film being etched.*

However, Applicant again respectfully disagrees.

First, it would not have been obvious to combine Nishioka disclosing a method for <u>detecting time for termination of surface layer removal processing</u> with Jackson disclosing <u>a diffraction grating</u>, absent a reading of Applicant's specification.

Additionally, it would not be obvious to use chrome and quartz as a mask and substrate,

respectively, in Nishioka because the material 2 (e.g., silicon oxide layer 2) must rest on a material with a different reflectivity beneath to allow an intensity detection signal to indicate a change of reflectance and an etching endpoint.

Also, in Nishioka, the reflectance of material 2 changes as an etching process progresses through the material 2 itself. In Nishioka, it is the layer being etched that causes the endpoint signal to change. Reflectance signals from other materials (e.g., including resist layer 3) are monitored but are only used as background to be measured against by the reflectance signal from the etched material 2. Therefore, Nishioka would not have ben combined with Jackson as asserted by the Examiner.

Further, Jackson also does not teach or suggest that a reflective material may be isolated from an etching process. Indeed Jackson merely discloses a diffraction grating and is completely unrelated to the method of etching a substrate of the present invention.

Thus, even if Nishioka and Jackson were to be combined (arguendo) there would be no teaching or suggestion of "*said reflective material is isolated from an etching process*", as defined by independent claims 1, 12, and 23 (nor of dependent claims 2-11, 14-22, and 24-29 and new claims 31-33).

Further, the other prior art of record has been reviewed, but it too even in combination with Nishioka and Jackson fails to teach or suggest the claimed invention.

IV. FORMAL MATTERS AND CONCLUSION

Regarding the drawings objection, Applicant notes that Figures 1A-3B are "Related Art", as clearly indicated in the specification, not "Prior Art" as alleged by the Examiner. These Figures 1A-3B were not published or known outside the confines of International Business Machines Corporation prior to the filing date of the application, and hence cannot be used against the claims of the present application. Indeed, Applicant purposely avoided the label "Prior Art" to guard against such an eventuality. Thus, to label these Figures as "Prior Art" would be erroneous.

Further, Applicant hereby submits a Submission of Proposed Drawing Corrections for Figures 1A, 2A, and 3A to include reference numbers described in the specification.

In view of the foregoing, Applicant submits that claims 1-33, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to the assignee's Deposit Account No. 09-0456.

Respectfully Submitted,

46,060

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

The claims have been amended as follows:

1. (Amended) A method of etching a substrate, comprising:

measuring a reflectance signal from a reflective material deposited on said substrate as the substrate is being etched;

correlating the substrate etch rate to the reflectance signal from the reflective material; and

using the etch relation between the substrate and the reflective material to determine the etch target,

wherein said reflective material is isolated from an etching process.

7. (Amended) The method of claim 1, wherein said reflective material comprises metal having a metal oxide thereon, and said substrate etch also etches said metal oxide on said metal, and wherein the reflectance correlation uses said metal as a secondary film only to correlate, and trigger an endpoint on the substrate as a primary film being etched,

wherein an output being monitored for endpoint detection is not physically representing [a] the primary film being etched.

12. (Amended) A method of etching a material, comprising:

measuring a reflectance signal from a correlation material that is removed from the path of a second material that is to be etched as the second material is etched;

correlating the second material etch rate to the reflectance signal from the correlation material; and

using the etch ratio between the correlation material and the second material to determine the etch target,

wherein said correlation material is isolated from an etching process.

18. (Amended) The method of claim 12, wherein said second material etch also etches a metal oxide on said metal, and wherein a thin film reflectance correlation uses said metal as a secondary film only to correlate, and trigger an endpoint on the second material as a primary film being etched,

wherein an output being monitored for endpoint detection is not physically representing [a] the primary film being etched.

23. (Amended) A method of etching a semiconductor substrate, comprising:

measuring a reflectance signal from an opaque material deposited on said semiconductor substrate as the semiconductor substrate is being etched;

correlating the semiconductor substrate etch rate to the reflectance signal from the opaque material; and

using the etch relation between the semiconductor substrate and the opaque material to determine the etch target,

wherein said opaque material is isolated from an etching process.

29. (Amended) The method of claim 23, wherein said opaque material comprises metal having a metal oxide thereon, and said substrate etch also etches said metal oxide on said metal, and wherein the reflectance correlation uses said metal as a secondary film only to correlate, and trigger an endpoint on the substrate as a primary film being etched,

wherein an output being monitored for endpoint detection is not physically representing [a] the primary film being etched.